

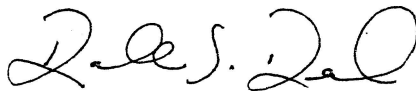
QUARTERLY PROGRESS REPORT

DRD 875MA-003

January 2003 - March 2003

**Marshall Space Flight Center
Safety and Mission Assurance Mission Services Contract
NAS8-00179**

Approved:

A handwritten signature in black ink, appearing to read "R. S. Reed".

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April 11, 2003

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1.0 INTRODUCTION

Hernandez Engineering, Inc. (HEI) successfully performed all required activities and tasks, as described in this report, in fulfillment of their Safety and Mission Assurance (S&MA) Mission Services Contract (NAS8-00179) with NASA's Marshall Space Flight Center (MSFC). This report covers a three-month period of the contract's second quarter of the second option year: January 2003 through March 2003.

2.0 GENERAL MANAGEMENT

2.1 Data Requirements

The second quarter of the second option year of the S&MA Mission Services contract was successfully completed on March 20, 2003. All Data Requirements (DR) Documents were submitted on or ahead of schedule throughout the quarter. They included DRD 875CD-001 On-Site Employee Location Listing; DRD 875MA-002 Financial Management Reports; DRD 875MA-003 Progress Reports (Monthly/Quarterly); DRD 875MA-006 Operations Plan, Problem Assessment Center (PAC); DRD 875MA-007 Quarterly Open Problems List; DRD 875MA-008 Monthly Newly Opened/Closed Problem Summary; DRD 875SA-002 Mishap and Safety Statistics Reports; and Quarterly Safety Performance Evaluation.

2.2 Personnel Status

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3.0 BUSINESS MANAGEMENT

We have experienced no financial or business management problems during this period. We are working closely with NASA procurement during the continuing resolution to effectively transition into the new contract year. We attribute this to close attention to details, effective use of established controls designed to efficiently respond to program changes---both anticipated and unexpected---and the continuing support of our corporate financial group's dedicated efforts at controlling overhead expenses.

The contract continues to have a total cost underrun at the end of this period---see the March 2003 Monthly Financial Report, DRD 875MA-002, for specifics. Attachment 2, Man-Hours Expended, of this report contains a description, by major task, of the total man-hours expended this period. F

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4.0 PERFORMANCE OF WORK AND USE OF FACILITIES AND EQUIPMENT

4.1 Safety

4.1.1 Industrial Safety (IS)

The Industrial Safety (IS) group initiated the CY03 OSHA compliance annual facilities inspections; performed 110 OSHA compliance facility inspections and provided all required reports in a timely manner. Also, IS performed 687 construction site compliance inspections to monitor adherence to OSHA and MSFC safety standards. All facility safety violations were documented in the HAZTRAK databases in order to assure MSFC's compliance with OSHA, NASA, and other consensus code requirements.

Among other activities, IS: (1) updated three facility fire evacuation plans; (2) participated in four pre-construction conferences; (3) performed eight final safety inspections of facilities under renovation or construction; (4) reviewed 68 sets of facility design drawings for compliance with OSHA and consensus codes; (5) taught one S&MA training class for critical lift monitors; and, (6) assisted QS50 develop and process, for web page posting, three safety bulletins and two Shop Talk safety information topics.

Regarding the assigned Area of Emphasis to increase awareness of identifying Unsafe Acts in the workforce, IS initiated numerous meetings with our primary customer, the Industrial Safety Department (ISD) to plan approved activities. In addition to identifying several unsafe acts during annual facilities inspections, IS prepared a draft letter, to be signed by the Center Director asking all civil service and contractor supervisors to increase vigilance in identifying the unsafe acts that occur in their respective work places. Our IM Group is actively working with the ISD to provide a Safety, Health, and Environmental (SHE) web page for all employees to report unsafe acts.

IS provided (b) (4)) to assist the SHE Communications and Training Teams and general communication of safety awareness to all MSFC employees. Assistance included: (1) wrote several safety articles for publication in the Marshall Star; (2) prepared and processed, for web page posting, the weekly SHE highlights and monthly SSWP safety required and optional focus topics; (3) prepared monthly SHE communications plans; (4) developed multiple innovative safety awareness communications materials including safety announcement on MSFC TV; and, (5) prepared numerous safety handouts for the Safety Fair at Oakwood College.

IS initiated, completed or followed-up on more than a dozen hazard analyses. Examples included: (1) initiated an Operating Hazard Analysis (OHA) for the transportation and handling operations to move the Gravity Probe-B (GP-B) from Moffet Field, CA to Vandenberg, CA; (2) continued to perform a SA for the high visibility Propulsion Research Laboratory (PRL), now under construction; (3) completed a safety assessment (SA) for Semi-Conductor manufacturing in building 4566; and; (4) initiated a SA for the Bipod Thermal/Vacuum Teat at Test Stand 300.

IS continued to support the implementation of the NASA lifting standard, NASA-STD-8719.9 by providing day-to-day advice and assistance to S&MA customers. In addition to initiating the OHA for the GP-B, IS participated in the on-site Ground Support Review in Moffet, CA and Vandenberg, CA, IS: (1) assisted AD42 develop the Transportation and Handling Procedure for the GP-B move operations; and, (2) advised civil service and contractor managers, supervisors and employees on requirements for lifting equipment proficiency testing in support of the MSFC Personnel Certification Program.

As a continued significant strength, IS continued to provide dedicated, full-time safety and quality support to the MSFC Test areas. Examples of support included: (1) reviewed and approved numerous operating procedures, such as for the 24" Solid Rocket Motor; (2) supported the planning meetings for firing a replica of John Goddard's 1926 rocket, which included performing explosives quantity-distance calculations; and, (3) provided daily support to test engineers and S&MA personnel on technical issues to include performing numerous test procedure reviews.

4.1.2 System Safety Engineering

System Safety tabulated previous baseline 2GRLV S&MA requirements to compare against suggested initial OSP Level II requirements in preparation for planned project level discussions. Either previously agree upon requirements and/or the original requirement was copied into a new database to assist in tracking the development of OSP Level II requirements.

System Safety reviewed the DART Project and S&MA Plans and generated changes to improve content and align plans with the current project status. The S&MA Plan was delivered on time. Suggested

changes to the DART Project Plan were also documented and delivered to the S&MA Lead for consideration.

System Safety Engineering (SSE) completed the Hazard Analysis checklist after numerous RSRM S&MA team meetings and discussions, resulting in the completion of the CoFR IA checklist sheets. The Audit was held on Tuesday, December 3, and the RSRM S&MA team had supporting documents to show how we do RSRM work/business.

SRB SSE prepared charts for an audit of the CoFR process. The audit was performed to determine methods used in the CoFR process, procedures and documents used identifying the process, and any tools used (i.e. NSTS 22254 Risk Matrix).

SRB SSE supported the STS-107 PAR. SRB presented two topics to the PAR community. A connector failure in which the connector pin did not have sufficient retention was presented. The topic of paint chips found in Booster Separation Motors was also presented. Anomaly Resolution Teams have been formed for both issues. Rationale has not yet been developed for the issues. Both issues are a constraint to the launch of STS-107. The issues will be presented at the PAR-Tag Up.

SSE submitted the final Safety Verification Tracking Logs (SVTL) (both flight and ground) to the Payload Safety Review Panel (PSRP) after completion of all ground processing at KSC. G-LIMIT has been turned over for stowage, and launch on ULF-1.

Payload Safety Engineering (PSE) continued its work on the updates to the WRS portion of the Node 3 Phase II hazard reports. Node 3-0047 is ready to be passed on to the Node 3 S&MA team for review. Node 3-0025 and Node 3-0026 are still in work and are awaiting additional information from the project.

PSE presented at the Node 2 Ground Safety Review. The Node 2 project overview, ground processing overview and safety assessments were presented to the Ground safety review panel (GSRP). The hazard reports (7) were presented and approved with minor comments, these comments were to remove the references to the shipping container and add mass data for the 1G floor panels.

Payload Safety Engineering submitted the MSFC managed Protein Crystal Growth (PCG) Single Thermal Enclosure System (STES) with Protein Crystallization for Microgravity (PCAM) STS 114 / ISS ULF-1 mission payload flight and ground Safety Compliance Data Packages (SDPs) to the Payload Safety Review Panel and the Ground Safety Review Panel.

SRB System Safety Engineering investigated an issue that was a possible constraint to the launch of STS-107. Tests being performed at Marshall revealed that material properties on a similar ETA ring were not sufficient to provide the required 1.4 factor of safety. A waiver was taken to fly in the as built configuration.

ET System Safety Engineering manned the ET S&MA Console at the HOSC in support of STS-107 launch. The External Tank S&MA worked one issue concerning operating pressure for pneumatic systems when activating LH2 and LO2 vent valves. The OMRSD requirement was 750 +/- 50psig. An exception was dispositioned against the OMRSD raising the pressure to 850psig. The flight rationale used to approve the exception was that the design & ultimate pressure for the valve was well above the 850 psig. The flight went off with out any other problems for ET.

Payload System Safety Engineering participated in the Pre-Ship/Acceptance Review follow-up actions, including final submittal of the Certification of Payload Safety Compliance form, and final coordination

of the Safety Verification Tracking Logs (SVTL) (both flight and ground) with the Payload Safety Review Panel (PSRP). G-LIMIT has been turned over for stowage, and launch on ULF-1.

System Safety Engineering participated in the MGM Pre-Ship/Acceptance Review follow-up review, which were successfully completed. Note: MGM launched on STS-107 on 1/16/03.

Payload Safety Engineering (PSE) has updated the Node 2 ground hazard reports and will obtain signatures and provide to KSC when the Node 2 team returns from Alenia. PSE also received the Node 2 transportation safety analysis from Alenia and is reviewing it prior to providing it to KSC ground safety review panel.

System Safety reviewed OSP Level I requirements, Draft Human Rating requirements, and agency requirements to develop a set of safety and mission assurance Level II requirements. Efforts shall continue to document requirement flows from Level I or agency requirements to the proposed Level II requirements. A matrix is being designed to track requirements including the origin, suggested wording changes, and if they are non-negotiable.

System Safety participated in the Demonstration of Autonomous Rendezvous Technology (DART) Mission Unique Critical Design Review (MUCDR). Safety illuminated several issues with a lack of either maturity and/or detail during the MUCDR. System Safety suggested several areas to be closely followed by MSFC S&MA to ensure issues are satisfactorily resolved.

ET System Safety Engineer is continuing to work the Columbia Investigation. Presently for the investigation the ET Assurance Team is preparing a Phase II presentation for QS01 on the External Tank, with an emphases on the Thermal Protection System (TPS) and the Bipod area.

SRB SSE supported an issue that was a possible constraint to the launch of STS-114. Tests being performed at Marshall revealed that material properties on a similar ETA ring were not sufficient to provide the required 1.4 factor of safety. The problem was found prior to the launch of STS-107.

PSE delivered the updated ground hazard reports to the ground safety review panel. Comments received back were favorable. The weight of the 1-G floor pieces exceeding 50 pounds will be addressed to allow a two-person lift when handling these pieces of floor.

PSE continued making updates to Node 3 Hazard Reports as required by comments received from the NODE 3 Phase II Safety Review Panel (SRP) review held at JSC Nov. 18 to the Nov. 22, 2002. Payload Safety is also continuing the parallel updates to the rack level Oxygen Generation System (OGS) Safety Analysis. Payload Safety provided support for MSFC/Hamilton Sundstrand on-going analysis/assessments of previously defined OGS/Node 3 failure scenarios.

SSE produced System Safety assessment charts for the ProSEDS Pre-Ship Review. The Pre-Ship Review was scheduled for 02/20-21/03.

SSE provided Computer Aided Fault Tree Analysis (CAFTA) fault tree analysis support to the Shuttle Systems Contingency Team analyzing the STS-107 mishap. Safety Engineering facilitated the team's fault tree development to direct and document their analysis efforts. Safety Engineering also provided consultation, regarding the CAFTA software capabilities, to the External Tank and Reusable Solid Rocket Motor Contingency Teams.

ET SSE immediately began participating in the investigation on 2/1/03, working with the S&MA community at MSFC and MAF to fulfill any immediate needs for Hazard Report information for the

External Tank and the Integrated Hazards of the Space Shuttle Vehicle. Presently, the ET Assurance Team is preparing a Phase II presentation for QS01 on the External Tank, with emphases on the Thermal Protection System (TPS) and the Bipod area. The Phase I presentation was performed on 2/6/03.

SRB System Safety supported an issue that was a possible constraint to the launch of STS-114. Tests being performed at Marshall revealed that material properties on a similar ETA ring were not sufficient to provide the required 1.4 factor of safety. The problem was found prior to the launch of STS-107. Hardness testing is being performed on ETA rings in flight inventory to determine material properties. Plans are ongoing to resolve the issue.

RSRM Systems Safety created a matrix evaluating the RSRM Hazard Reports failure causes (over 1100 of them) with the RSRM Investigation Working Group's Fault Tree, and presented our finds to the RSRM Investigation Working Group. After the HEI consultants reviewed the Fault Tree, there were some additions/corrections made. S&MA is updating the matrix to incorporate these corrections.

Payload Safety reviewed the Vapor Compression Distillation (VCD) Flight Experiment (FE) as requested. The results of this review were submitted to S&MA. Payload Safety also provided S&MA some historical information of previous Columbia upgrades from information taken from a book on the Space Shuttle History or the first 100 flights. This information also included a presentation on the Micro-Meteoroid Orbital Debris (MMOD) Wing Leading Edge Sub System (LESS) Protective Shield Study.

PSE reviewed the Phase III Flight Safety Data Package & the Phase III Ground Safety Data Package. Comments have been sent to University of California Irvine (UCI).

SSE supported the Technical Interchange Meeting (TIM) between Technospazio and NASA JSC Payload Safety Review Panel (PSRP). The TIM was conducted to allow Technospazio to determine the key safety issues in the development of the Europa payload, which is designed to function on the Express Pallet, which will be mounted externally to the International Space Station. System Safety provided comments to the package presented via telecon during the TIM.

System Safety supported submission of the phase II GSDP to the MSRR-1 team for internal review prior to release of the package.

PSE continued support to the MSFC managed Protein Crystal Growth (PCG) Single Thermal Enclosure System (STES) with Protein Crystallization for Microgravity (PCAM) payload manifested for the STS 114 / ISS ULF-1 mission by coordinating disposition to comments (minor in nature) from the Ground Safety Review Panel (GSRP) to the ground Safety Compliance Data Package (SDP).

ET SSE traveled to MAF for two days of interface meetings with the ET Contingency Working Group. System Safety participated in several activities including the dissecting of a High Fidelity Bipod Model. Several models will be used for practice before the dissection of the ET-94 Flight Hardware.

PSE participated in a teleconference to formulate procedures that do not require the crew to wait 6 hours for the MSG electronics box to cool down before starting maintenance or trouble-shooting procedures. The conference found safe alternatives on the basis of thermal data from the MSG. Payload Safety reviewed the Investigation Interface Requirements Document and provided comments to the MSG change control board.

PSE has continued to submit Node 2 Verification Closure Statements (VCS) for Verification Closure Notifications (VCN's) or update VCN's with additional data that have already been submitted for closure. At this time 13 VCN's remain open, with 5 of these requiring additional data to be provided at the FAR.

VCN's that have been submitted have been signed with the exception of 6 of them; these VCN's are requiring additional data or clarification of the data presented.

SSE reviewed the S&MA portion that has been integrated into the DART Project Plan and generated comments, questions, and recommended specific changes when possible. All comments were communicated to the S&MA Lead and the project for consideration. Additionally, comments against the delivered FMEA/CIL were documented and formally provided to the DART Vehicle contractor through the S&MA Lead and the project's COTR.

In support of the investigation for the External Tank (ET), Project Assurance Specialist developed matrices for each primary branch of the ET fault tree that related ET Hazard and CIL codes and Integrated Hazard codes to the appropriated fault tree blocks. This was a traceability effort to assure all fault tree blocks were associated with a CIL code.

ET SSE completed the analysis of the ET Hazards, Integration Hazards, & ET FMEA Causes versus the ET Contingency FT. The comparison/analysis has lead to just a few questions for the Contingency Team and should be able to be cleaned up by 4/4/03 to the S&MA management.

Safety Engineering (SE) and others from the SSME team participated in an SSME system safety and reliability "face-to-face" meeting at Pratt & Whitney on March 18 and 19. Process flows for hazard report and FMEA/CIL updates were discussed, in terms of existing processes as well as what process improvements can be made, and flow diagrams were developed to document the processes that the attendees agreed will be used for both activities.

Payload safety is reviewing the Node 2 FAR data package. At this time 3 issues have been discussed, these are the lack of the ammonia fittings being procured as fracture critical hardware, negative margins of safety for the Extravehicular activities kick-loads on the Meteoroid Debris Protection System (MDPS) panels located in the translation path and the use of staples to secure the Velcro to the multi-layer insulation. The staple issue has been resolved, at this time, with Alenia removing the staples and replacing them with a metallic rope thread. The remaining two are being worked.

PSE is working on completing the final draft of the Phase III Flight Safety Data Package for the Delta-L, the Hazard Reports and the Safety Verification Tracking log. PSE is working with Microgravity Science Glovebox (MSG) on the integration of the packages for the Integrated Review.

PSE is working with the team on Safety Verifications closures. OPCGA and TES team members are working to get as many safety verifications closed prior to attending the Phase III Safety Review scheduled for April 22, 2003.

PSE received comments from the preliminary thermostat hazard analysis sent to the Payload Safety Review Panel (PSRP). A preliminary response to these comments has been generated and is in the process of being reviewed by the MPLM Project. Updates are also being made to the MPLM Programmable Thermostat hazard analysis based on PSRP comments.

Payload Safety provided a copy of the Kit for External Repair of Module Impacts (KERMIT) phase I safety assessment to FD-24 (MPLM Group) for information purposes.

Payload Safety continued support to the MSFC managed Protein Crystal Growth (PCG) Single Thermal Enclosure System (STES) with Protein Crystallization for Microgravity (PCAM) payload manifested for the STS 114 / ISS ULF-1 mission by coordinating closure disposition for open items remaining on the Verification Tracking Logs (VTLs).

Payload Safety continued update of the Solar-B Hazard Analysis. Payload Safety also provided review and comment to Lockheed Martin documents provided in support of the Solar-B Project. These documents were: SOLAR-B Focal Plane Package (FPP) Sub-System Hazard Analysis (SSHA); FPP Failure Modes and Effects Analysis; and FPP Handling and Transportation Plan.

Project Assurance Specialist supported the safety working group by reviewing latest draft of the new revision of S/W Safety Standard, STD-8719.13B. Comments offered included suggestions for improved plan requirements for linkage of safety analysis and software redevelopment cycle of the software and the need to explain the "organizational freedom" path identified in the draft.

4.2 Reliability

4.2.1 Reliability & Maintainability Engineering (R&ME)

In support of the Advanced Projects Assurance Department, R&ME continued providing R&M discipline support to the Orbital Space Plane (OSP) and Next Generation Launch Technology (NGLT) programs. R&ME attended the OSP System Requirements Document development review kickoff meeting and is participating in the process of OSP Level II requirements development. R&ME participated in the RS-84 Engine System Design Review held at MSFC and raised a concern regarding the seemingly overly optimistic nature of the RS-84 R&M predictions, which are based on adjusting SSME demonstrated reliability data to account for differences in RS-84 design and operation. R&ME also participated in an RS-84 Operability TIM at Canoga Park, where these concerns were further elaborated and addressed. R&ME continued to work with the Demonstration of Autonomous Rendezvous Technology (DART) and X-37 program prime contractors to ensure that concerns regarding the FMEA for these projects are appropriately resolved.

In support of the Shuttle Assurance Department, significant R&ME activities included participation in the flight readiness review and launch support activities for STS-107 as well as active participation in various anomaly resolution teams. R&ME supported the ongoing STS-107 accident investigation activities by researching and analyzing FMEA/CIL and Hazard Report data for each of the propulsion elements, preparing and presenting summary materials, supporting development of the fault tree analyses, and other requests as directed. Additionally, R&M continues to support ongoing effort related to Shuttle Upgrades, including active participation in the ET friction stir weld process implementation, as well as in the qualification process for the SRB Command Receiver Decoder and Altitude Switch Assembly. R&ME participated in the 2003 Reusable Solid Rocket Motor (RSRM) Operations and Maintenance Requirements Specification Document (OMRSD) & Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) audit at Kennedy Space Center to verify that the various tests and inspections that are identified as retention rationale in the RSRM Critical Items List are properly implemented in the OMRSD system. R&ME also participated in a Reliability & System Safety audit of the Honeywell Space Shuttle Main Engine (SSME) Controller Advanced Health Monitoring System (AHMS) program to determine compliance with Honeywell's Reliability & System Safety Program Plans.

In support of the Cargo Assurance Department, R&M continued development and program coordination of verification-closure documentation to support the Node 2 requirements verification activities. All Node 2 R&M requirements have been closed or are on track for closure prior to the Node 2 Final Acceptance Review. R&ME continued development of the Node 3 FMEA/CIL and provided the FMEA data to Alenia to support development of the Failure Detection, Isolation, and Recovery (FDIR) analysis. R&ME completed development of the FMEA/CIL for the Regenerative ECLSS Oxygen Generation Subsystem and Water Recovery Subsystem and is in the process of re-releasing the documents. R&ME continued development and coordination of the FMEA for the MPLM shell heater programmable thermostats that

are being developed in-house by MSFC. R&ME also supported the Material Science Research Rack-1 (MSRR-1) project by reviewing the reliability data for the Active Rack Isolation System (ARIS) controller, which is a significant driver of MSRR downtime.

4.2.2 Problem Assessment Center (PAC) Operations

HEI's PAC personnel processed and coordinated disposition of problem reports, supported launch milestones, coordinated the MSFC Problem Assessment System, supported the Columbia accident investigation, and operated the Corrective Action System (CAS). The PAC received and entered 19 new problem reports (PRs) into MSFC's Problem Reporting and Corrective Action (PRACA) System, coordinated MSFC interim closure of 19 PRs, received 8 prime contractor closure recommendations, supported MSFC full closure of 11 PRs, coordinated non-problem closure of 4 problems, and performed 184 individual PR database updates and reviews. We conducted 4 SSME problem review boards (PRBs) resulting in the disposition of 16 of 16 problem reports presented and issued PRB minutes through February. The PAC generated or updated trends for all SSME, RSRM, and SRB problems submitted as newly opened or for closure. We also generated and distributed monthly problem bubble trend risk charts (including active problems status, ages, and raw and moving average new problems over the last 13 months) and briefed them at the monthly SRB Problem Assessment System (PAS) review and the RSRM Project Manager, along with her direct reports and prime hardware contractor.

The PAC supported 2 tag-up PARs, the FRR, and L-2 FRR for STS-107 in addition to its Level A countdown and launch coverage. We also supported the ET/SRB Mate Review, the Orbiter Rollout Review, and the PAR for STS-114. Following the STS-107 Columbia accident, we performed various data searches regarding prior ET foam situations, provided ET problems and in-flight anomalies (IFAs) for internal use and in response to Freedom of Information Act (FOIA) requests, assisted in staffing the S&MA Action Center, and coordinated MSFC S&MA participation in the Mishap Response Team (MRT) and NASA Accident Investigation Team (NAIT) teleconferences – distributing discussion charts, taking meeting notes, and distributing the notes along with an overview of significant teleconference discussions. We also provided background data to S&MA on PRACA processing for use in Columbia investigation briefings.

In problem system coordination, the PAC conducted 2 SRB Problem Assessment System (PAS) status reviews for the SRB Chief Engineer and other SRB Project and S&MA personnel and reviewed wording for SDOS/TBE contract problem reporting requirements. In cooperation with HEI Information Management, the PAC assisted re-opening of the MSFC PRACA database following the system impoundment resulting from the Columbia incident. We also found that 21 specific SSME problem reports had invalid FMEA references and obtained correction from the prime hardware contractor. Furthermore, we located 4 SSME problems whose disposition rationale had been omitted from the database due to system loading issues and initiated contractor updates.

The PAC provided various problem data in support of NASA and MSFC analyses. Regular activities included providing daily KSC PRACA shuttle problem summaries, daily MSFC PRACA open-against-next-mission summaries, daily KSC Resident Office reports, monthly HEDS new shuttle problem charts, monthly newly opened/closed problem summaries, weekly SRB PRACA and ALERT status reports, and quarterly Open Problems List (OPL). Special activities included: (1) finalizing charts and providing recommendations regarding the S&MA Employee Survey for S&MA, reviewing 2 years of SSME alternate turbopump (ATP) problems; (2) extracting, formatting, and distributing SRB IRD and RSD problem listings for ED; (3) providing a list of all MSFC PRACA interim closed problems to JSC Shuttle Integration per their request; (4) providing the problem history on contamination in the SSME fuel preburner; (5) researched and provided SSME problems over the last 10 years related to flight orbital debris (FOD); (6) providing SSME TVC actuator quadrapod strut mounting bracker problems; and

tabulating the 14 year problem history on certain specific SRB hardware components with recent reduced numbers of problem reports.

(PWS 6.3.3) In implementation and operation of the MSFC CAS, we received 53 potential CAS reports, screened 49 draft Recurrence Control Action Requests (RCARs), and initiated 7 new RCARs. We received 6 responses from laboratory points of contact with either disposition rationale or response extension requests. We coordinated Corrective Action Board review of 7 RCARs (resulting in full closure of 4 of them). We also provided open RCAR status reports and discussed them at the Marshall Management System (MMS) Implementation Team meeting, issued monthly RCAR status and delinquent response reports, presented monthly metric charts of RCAR activities and statuses at the MMS Implementation Team. We coordinated DCB review and approval of 4 MWIs/MPGs on Corrective Action and assisted Information Systems in clearing the CAS data system following impoundment due to the Columbia accident.

4.2.3 ALERT Program

HEI's ALERT support included both regular and special activities as we coordinated MSFC ALERT processing. HEI received and distributed 24 ALERT announcements for MSFC review and obtained 1,228 responses from MSFC project, contractor, and laboratory contacts. HEI ALERT: (1) reviewed and approved 11 new MSFC ALERT database accounts via the TPS security. We generated monthly Open, Delinquent ALERT response tabulations and provided them to S&MA and/or Directorate single points-of-contact responsible for open ALERT reduction; (2) facilitated re-organization of FD HOSC support equipment ALERT actionees; (3) assisted DART in evaluating their contractor's ALERT processing impact; (4) reviewed SLI ALERT processing estimates; and (5) reviewed wording of the SDOC/TBE ALERT processing contract requirements. PAC personnel also drafted the MSFC ALERT presentation for discussion at the April NASA ALERT representatives meeting at NASA Headquarters. We participated at the GIDEP business meeting in Orlando and served as recording secretary at the first monthly GIDEP Industry Advisory Group (IAG) teleconference – publishing notes and action items.

4.3 Quality

Space Transportation

External Tank (ET) Quality Engineering (QE) assessed results of a subcomponent test performed on Composite Nose Cone graphite/phenolic material. QE participated in an ET quality escape telecon to evaluate Lockheed Martin nonconformance documents and KSC problem reports for the months of January and February and prepared a quality escape report documenting the findings. In addition, ET QE has been participating in the STS-107 Columbia Accident Investigation by providing the following support: (1) prepared an action response to a request for MSFC S&MA and contractor supplied metrics that are used to judge the health of the Project; (2) participated in the preparation of an action response to a request for identification of quality inspection personnel and inspections performed per delivered hardware; (3) performed a comparison review of ET fault tree compliance for the ET electrical FMEA by reviewing FMEA failure causes and identifying corresponding fault tree blocks; and, (4) has worked with the ET Contingency Team to coordinate quality requirements for test article preparation and testing associated with the STS-107 investigation.

Solid Rocket Booster (SRB) Quality Engineering (QE) supported weekly Booster Separation Motor (BSM) upgrades and weekly BSM team meetings to status production schedule, qualification schedule, and status of open vendor problem reports. QE supported the investigation of Foreign Objects Debris (FOD) on BSM Forward Dome Liner, evaluated SRB Pyrotechnic hardware Vendor Problem Reports, evaluated SRB Elements Engineering Change Proposals, and supported Integrated Electronics Assembly Upgrades and the USA-UPCO Weekly Pyrotechnic Working Group meetings. QE also supported the Automated Dynamic Acceptance Procedure Test Stand (ADAPTS) preliminary readiness review,

preliminary design review requirements, developed quality requirements for ADAPTS sourced items, and provided quality input to the Program Plan TD62-PL-006, Build Requirement Document TD62-PL-008, Performance Requirement Document TD62-PL-007, and Drawings/Specifications. The STS-107 Investigation was supported by QE at United Space Alliance (USA) at KSC and at MSFC with the review of Build Paper and Qualification Records.

Space Shuttle Main Engine (SSME) Quality Engineering (QE) traveled to Pratt & Whitney with SSME S&MA management in January to determine the areas to be audited in the phase I and phase II portions of this year's NEQA. Also in January, a technical interchange meeting (TIM) was held at MSFC concerning the Ball Strut Tie Rod Assembly (BSTRA) cracks found inside the space shuttle Discovery's feed lines. QE evaluated the work performed during the TIM to produce acceptable flight rationale resolving the BSTRA ball crack, provided periodic briefings to S&MA management, and evaluated the development of new inspection methods. Throughout the quarter, QE has evaluated the work performed in the development of the Gimbal Test Article (GTA). The GTA is a flight-like feed line section to be used in evaluating the effect of back flow environments produced by the SSME low pressure fuel pump on the flow liner section of the feed line. Cracks have been found on the flow liner section of the feedlines on all three shuttles and a weld repair was incorporated for a short-term solution. The GTA program's focus is to define and bound the flight environment through incorporating the test article into the SSME ground test program. The program is presently developing new ways of detecting and relieving residual stresses recently discovered in the flow liner after assembly due to lack of margin for engine testing. QE has and will continue to evaluate the work associated with the GTA program. In the month of February and March after the Columbia accident, QE provided Project Assurance support and normal QE support to the SSME program concurrently with support to the Columbia Accident Investigation S&MA Action Center. The increase in responsibility was a direct result of the SSME Project Assurance person's re-assignment to the SSME Investigation Working Group. QE supported the Columbia Accident Investigation S&MA Action Center by coordinating efforts to properly control STS-107 documentation under contingency plan guidelines, facilitated data requests, coordinated S&MA actions to the SSME team, and developed presentation material.

Reusable Solid Rocket Motor (RSRM) QE reviewed engineering change proposals, process change proposals, and Material Review Board items for quality and certification impact. QE also attended and reviewed information presented at RSRM milestone reviews, and weekly RSRM propellant, liner, and corrective action reviews. RSRM QE also participated in the ongoing accident investigation activities associated with the STS-107 mishap investigation.

Software Quality Assurance (SQA)

Software Assurance (SA) monitored Material Science Research Rack (MSRR) pre-Combined Components Interface Testing (CCIT)-2 Software Interface Testing and Functional Regression Testing activities of pre-released Flight Software (FSW) Operational Increment (OI) 2.3 and Flight Software (FSW) Operational Increments (OI) 2.3.5 and 2.3.6. SA also witnessed the RAD6000 FSW OI 2.3.6 Load and Test Software Load version 1.2 on the MSRR-1 Master Controller (MC) Ground Unit and the subsequent Functional Verification performed by ED13.

SA provided support to the ED14 Peer Review Process for Material Science Research Rack (MSRR-1) by reviewing Test Procedures and Software Requirement Specification (SRS), submitting a Finding Logs addressing concerns and issues, and participating in discussion sessions with other members of the Peer Review Process. In addition, SA utilized available resources and provided support to the ED14 Test Procedure Peer Review of Urine Process Assembly (UPA).

SA provided support to the ED14 Software Process Improvement (SPI) Level 3 Software Capability Evaluation (SCE) Preparation Session. During this activity, Level 3 Key Process Areas (KPA) of the

Software Engineering Institute (SEI) Software Capability Maturity Model (CMM) goals and key practices were reviewed and evaluated for levels of completion by ED14 organization and SA in preparation for the CMM Level 3 assessment in 5/03. In response to action items, SA Organizational Issuances have been reviewed and are in the process of updates, a checklist was provided to ED14 to define the criteria necessary for the development and approval of an SQA Plan, and criteria were defined and implemented in an SA database in the ED14 PVCS System Change Request (SCR) problem reporting system which will be used by SA to track Audit Findings and Observations for ED14 Organizational and Project Audits.

ISO

QE has continued to play a key role in ensuring the maintenance of ISO 9001 at MSFC during this time period. Efforts have dealt with continuing implementation of the ISO 9001:2000 revision, training, maintenance of documentation, internal quality audits, and planning and support for the NQA registrar audit, including preparation of self-assessment checklists for the MSFC organizations and follow-up and closure of corrective actions. QE provided general ISO support, including documentation reviews and consulting support on internal audits, training, continual improvement, records, planning for process changes, and other aspects of ISO 9001, to various MSFC Organizations.

QE has played a key role in analysis of the impact of implementation of AS9100 at MSFC. Efforts have dealt with identification of deltas, coordination with owners of documentation, review and revision of MSFC directives, and preparation of a matrix of MSFC documentation to the AS9100 requirements for review by NQA prior to the registration audit, currently scheduled for 6/17/03-6/18/03.

Payloads

Quality Engineering (QE): (1) performed an Independent Assessment for the Propulsive Small Expendable Deployer System (ProSEDS) that was presented at the pre-ship review during February 2003; (2) QE performed reviews of the Acceptance Data Packages for Gravity Probe-B (GP-B), Materials Science Research Rack (MSRR), Microgravity Science Glovebox (MSG), and Solar-B; (3) QE performed Quality System Reviews and supported a Test Readiness Review at Naval Research Laboratory (NRL) for SOLAR-B; (4) QE performed Drawing Reviews, Procedure Reviews, Procurement Reviews, Statement of Work Reviews, and attended team meetings for MSRR, GP-B, SOLAR-B, MSG, TES, BiC, ProSEDS, Delta-L, OPCGA, TIPMPS, SHIVA, QMI, ELCSS, MGM, GBM, EGN, and EXPRESS Rack; (5) QE performed an informal quality assessment of Plasma Processes, Inc. for Gravitational Effects on Distortion in Sintering (GEDS); (6) QE provided quality support for the Systems Requirements Review (SRR) for the Coupled Growth in Hypermonotectics (CGH) Particle Engulfment and Pushing by Solidifying Interfaces (PEP) Sample Ampoule Cartridge Assembly (SACA); and, (7) QE provided testing support for Gravity Probe-B (GP-B) Space Vehicle preparation for spin balance testing at Lockheed Martin in Sunnyvale, CA.

Inspection and Test

QS10 Quality Engineering prepared and provided the procedure for the requirements of the Foreign Object Damage and Foreign Objects and Debris (FOD). Quality Engineering reviewed and provided comments for the moving and handling procedure for the Northrop Grumman composite tank. Quality Engineering reviewed and released procedures for the test facility build up and the testing of the Northrop Grumman composite tank, the Laser Ignition system, and the Goddard Flight Replica.

QS10 Quality Assurance continued to provide support in all MSFC test areas to MSFC test engineers and contract support personnel. The plasma arc facility, Test Stand (TS) 115, TS 116, TS 300, TS 500, and the hot gas test facility are among the test areas supported by Quality Assurance. Test procedures and planning were reviewed to ensure that proper quality and test requirements are met on a day-to-day basis.

Quality Assurance performed receiving inspections and witnessing of assembly and testing for Vortex Thruster chamber, ProSEDS, Instrument Demonstration Motor, Gas Path Fundamentals, SRTM-1C, and Solid Fuel Torch among others. HEI Quality is providing assistance to the Columbia investigation. HEI Quality is also providing support in nondestructive inspection testing as required, particularly with the Olympus Videoscope system (borescoping and still pictures or movies as requested).

QS30 Quality Assurance personnel: (1) monitored vacuum baking procedures at the environmental test facility at Bldg. 4619; (2) performed receiving inspection on various flight items at NASA quality office in Bldg. 4705; and, (3) witnessed testing of various flight sub-Assemblies for programs such as Microgravity Science Glovebox (MSG), Material Science Research Rack (MSRR) and Urine Processing Assembly (UPA).

4.4 Information Management (IM)

Information Management (IM) coordinated activities in support of the STS-107 investigation. IM obtained data and full system backups of four applications potentially containing information pertinent to the investigation, impounded the media, and coordinated a waiver for the procurement of equipment to assist in backup and restoration activities. IM provided licensed software and created shared directories with restricted access for personnel assisting in the investigation. IM also produced a spreadsheet containing downloaded shuttle-related mishap information from the Incident Reporting Information System (IRIS).

IM modified numerous applications to improve functionality. Significant support was provided to the Inventory of Hazardous Operations (IHOPs) program in the form of application revisions, user support, and report creation. The Audited Vendor List (AVL), Limited Vendor List (LVL), and Project Specific Approved Supplier List (PSASL) web pages were modified to include an Inactive Supplier/History Page. IM performed a development review of the first phase of Safetrak; the application will be released for beta testing when comments are incorporated. The Supervisor Safety Web Page (SSWP) automated update programs were revised in preparation for a server migration, and a module was created to provide the Marshall Management System (MMS) audit manager and QS50 representatives access to metric data for contractor and civil service organizations. The Virtual S&MA web site and the Space Flight Awareness application revisions were completed and await OCIO review. The Certification Tracking System, S&MA's integrated login application, the Safety Contractor database, the Safety Concerns and Reporting System, the Hazard Tracking System, the Alerts Tracking System, and the Corrective Action System applications were also modified. IM also investigated methods of automating Unsafe Acts reporting. In addition, IM made significant progress in developing the Internal Quality Audit (IQA) application that will support the MMS audit process.

IM performed other activities to improve processes. Due to hardware failure, IM set up a new configuration management server. IM installed updated encryption certificates for S&MA's NT servers. (4c) Application migration activities were also supported. IM interfaced with CSC personnel to transfer center-wide applications supporting the MMS. In addition, IM migrated Problem Reporting and Corrective Action (PRACA) data from Oracle to mySql and began migrating Ansi C Sun Solaris/Oracle scripts to Linux/mySql. Completion of the migration will save MSFC yearly licensing and support costs for Solaris and Oracle. IM also produced instructions and generic programs that will improve standardization and productivity, including; 1) directions for setting up a Visual Studio.net project; 2) integrated login code for .net applications; 3) development of SQL Server cross-tab query capability; 4) an ASP.net module turning email functionality on and off to assure that emails are not distributed during testing; and 5) incorporation of information regarding requested application modifications onto spreadsheets that are located in a shared area. IM also provided a draft "Process for Assuring Security of S&MA Web Publications" for review. Monthly reports summarizing security support activities and data

were delivered to the Organizational Computer Security Official (OCSO), and beginning in March 2003, a report summarizing all IT activities was provided to the IT Manager.

Other support included meeting coordination supporting the NASA effort to replace IRIS. IM assisted QS10 in investigating methods of providing functionality to track requirements to deliverable documents. Two IM personnel also attended the MSFC-sponsored Risk Management training.

4.5 Human Exploration and Development of Space (HEDS) Assurance

During this reporting period, the MSFC HEDS IA group continued to support a wide range of S&MA activities. MSFC IA hosted the Independent Assessment Quarterly Summit with participants from HQ, Code Q, JSC and KSC. This meeting provided leadership from each of these organizations opportunity to identify best practices and enhance the value added benefit of the IA activity. All MSFC IA team members participated in this event.

IA participated in the S&MA team led STS-107 Electronic Meeting System Exercise which was formed to address questions concerning the EMS capabilities in Bldg. 4200/F13F.

A review and comparison of the Quality System Requirements of AS9100 and NSTS 5300 was conducted and presented to MSFC Space Shuttle S&MA personnel to determine that contents of NSTS 5300 are covered in AS9100. Following IA updates, a second review was conducted to list AS9100 requirements not contained in NSTS 5300.

At the request of QS40 management, IA began development of an S&MA contingency response Organizational Issuance (OI) to consolidate all required S&MA responsibilities in response to a declared contingency, and include instructions for contingency process verifications and notifications, and instructions for impounding, safeguarding and controlling access to S&MA contingency data.

IA worked with the PCA Quality Team to verify that documentation and traceability existed for the Biological Research Project and its components. Resulting actions were developed for various concerns that were discovered. The MSFC S&MA Lead for the project finalized all actions and presented at the closing meeting.

4.5.1 International Space Station (ISS) Independent Assurance

The Independent Assessment MH 2010, Payload Operations Integration Center (POIC) evaluation was completed and the report submitted to Independent Assessment management for review.

The final draft assessment report of the Flow Down of SSP 50431 into MSFC ISS Payloads Assessment #MH-2001 was completed and an electronic presentation developed for out-briefing meetings. The presentation was forwarded to MSFC S&MA Management for review and comments. MSFC S&MA Management was requested to arrange out-briefing meetings.

IA began an assessment of the processes that S&MA uses to satisfy the Certification of Flight Readiness (CoFR) implementation requirements defined in ISS program requirement documents.

4.5.2 Space Shuttle Independent Assurance

Independent Assessment MH 2011, Evaluation of Procurement Quality Control at Lockheed Martin Michoud, was performed. The ET Project Office established a team of experienced ET and process experts to evaluate the feasibility, potential benefits, and cost for implementing Lockheed Martin's Process Risk Assessment (PRA) at contractor facilities. The MSFC IA Assessor participated in this PRA evaluation team effort. Upon completion of the evaluation the, IA recommendations regarding the implementation of a Process Risk Assessment program at suppliers were accepted by the ET contractor.

An Independent Assessment MH-2013, Assessment of Engineering Test Motor 3 Design, Fab and Test began. Thiokol's first draft of documents and briefing packages provided by the IA Team Leader were studied. Notes and questions are being prepared to send to Thiokol for expansion and additional information.

IA conducted a Space Shuttle Program Certification of Flight Readiness (CoFR) Independent Assessment to evaluate the processes that S&MA uses to satisfy the CoFR implementation requirements defined in the SSP and ISS program requirement documents. QS01, QS20 and QS40 comments were recorded and incorporated. The MSFC IA team worked with the assessment lead at JSC to combine the assessment with that of KSC and JSC.

MSFC S&MA IA investigated the validity of allegations made in four newspaper articles about work and quality processes on the External Tank Program at the Michoud Assembly Facility in New Orleans, LA. None of the allegations were validated.

IA began the research for an STS-107 investigative fault tree development, analysis and closure process for MSFC managed shuttle elements in support of the Contingency Investigation S&MA Data Review Process.

4.5.3 Space Launch Initiative Independent Assurance

A working group composed of MSFC personnel, JSC's ISS Risk Manager and Futron personnel discussed means and methods of revising the ISS Risk Management Application (IRMA) and replicating it at Marshall Space Flight Center. The ORMA (OSP Risk Management Application) will be used to support the Continuous Risk Management effort. Futron demonstrated the capabilities of IRMA, and MSFC S&MA IA supplied requirements information regarding a start-up of the application at Marshall.

4.6 Project Assurance

Project Assurance Engineering (PAE) participated in the Orbital Science and Northrop Grumman Corporations midterm OSP presentations in Huntsville. In addition, PAE is supporting a feasibility study for launching an OSP on an expendable launch vehicle (ELV), with emphasis on human ratings, vehicle trades and crew survivability.

A stainless steel washer (foreign object) was observed during the disassembly of STS-113 (RSRM-86) in the bottom of one of the nozzle-to-case joint radial holes. An engineering assessment of potential worst-case impact to flight hardware did not indict any risk controls and rationale. Joint performance and sealing integrity are not impacted, and STS-107 and subsequent are safe for flight. RSRM Project Assurance documented this issue on a one-pager for the STS-113 Preflight Assessment Review (PAR).

Postflight assessment of STS-113 (RSRM-86) observed rubber flashing on the sealing element of five nozzle-to-case joint packing-with-retainers. Leak tests have verified seal integrity, and engineering flow testing has demonstrated high tolerance for packing-with-retainer defects. STS-107 and subsequent are safe for flight. RSRM Project Assurance documented this issue on a one-pager for the STS-113 Preflight Assessment Review (PAR).

SSME Project Assurance Engineering served as the focal point for the CoFR IA audit effort. The SSME response was coordinated with the entire SSME S&MA team, to ensure the cognizant personnel covered all areas, and the information recorded disseminated to the entire team for cross-training purposes.

The SSME PFA was held on 17 December, as coordinated by SSME Project Assurance Engineering at the direction of the SSME S&MA Team Lead. An excellent review was held with parties from all

S&MA levels being briefed on two updated technical issues as well as two issues that occurred during STS-113. The two subjects from the STS-113 launch included the fuel purge pressure spike seen in the data review and the Nozzle external leak that was identified during film review of the launch. Both issues, barring unforeseen findings during the investigations, were determined to be no constraint to the launch of STS-107.

SSME Project Assurance Engineering supported the STS-107 PAR by gathering information concerning the pertinent technical issues, and assisting in the preparation of the presentation materials.

Project Assurance Engineering represented QS20 during the performance of the Lot ABP SRB Range Safety Linear Shaped Charge (RSSLSC) Phase III Review held at United Space Alliance supplier Universal Propulsion Company. The supplier presented 12 Forward Initiation RSSLSC Assemblies, 12 Aft RSSLSC Assemblies and 49 Intermediate RSSLSC Assemblies for Phase III review. Final accept quantities are to be determined pending completion of material review on discrepancies identified during the Phase III Review.

The STS-107 PAR was conducted via teleconference December 20, 2002. HEI coordinated presentation material, transmitted presentation material to HQ, provided electronic presentation of material and provided back up support during the review.

Project Assurance Engineering participated in the Safety Readiness Review of the Northrop Grumman composite sub-scale cryogenic tank proof test. Presentations and discussion topics included overview, manufacturing, test engineering, analyses, quality, test process test setup and safety. The Board approved to proceed conducting the proof-test upon satisfactory response to the eight action items generated.

RSRM Project Assurance assessed the postflight observation on the RSRM-86 Safe and Arm (S&A) Device Arming Monitor. Minor discoloration was noted on the switch deck contacts away from the area of contact. Laboratory analysis showed that the discoloration was thin or missing gold plating. The team concluded that the condition of the plating would not affect mechanical or conductive properties of the contact; therefore, there will be no impact to the function of the S&A device.

RSRM Project Assurance (PA) supported the launch of STS-107 in the HOSC. No issues were observed RSRM during the countdown. The Quick Look Report showed nominal RSRM performance during operation with no flight anomalies.

Project Assurance supported the investigation into the recent report of out of family resistance values on the RSS S&A Device manufactured by United Space Alliance (USA) supplier, Pacific Scientific-West, Valencia, Ca. An in-process test on Lot AAB RSS S&A Devices produced unexpectedly high (although within specification) resistance values. Corrective action has been developed to minimize stresses on the flex circuit during connector disassembly and reassembly operations.

Project Assurance provided Level A support for the launch of STS-107. PA supported HOSC Safety and the each of the Shuttle Assurance Safety consoles. On its first launch attempt, Shuttle Columbia at 10:39 a.m. EST January 16, 2003.

The STS-113 FRR Tagup PAR was conducted via teleconference January 7, 2003. For both reviews HEI coordinated presentation material, transmitted presentation material to HQ, provided electronic presentation of material and provided back up support during the review.

Product Assurance participated in the Sunshade Protective Cover Options review at Stanford University (SU) during this reporting period. Two options were presented: Option 1 – Using the existing ridged (hard) cover that would prevent “heavy” debris from falling into the sunshade, and Option 2 – Fabricate a

new soft cover that would prevent contamination from debris more likely to be present at the launch pad. There is risk potential for contamination with either option.

Project Assurance Engineering attended a three-day Axiomatic Design class at the Lockheed Martin facilities in Huntsville, AL. This approach utilizes identifying independent and unique functional requirement and design parameter combination. If done properly, it eliminates redundancy, reduces changes and invites defining all functional requirements of a given project before starting the design. PAE is leading a team from various MSFC disciplines in a major review and analyses of the crew escape methodologies that were generated by the TA-9 contract with Boeing and the in-house advanced study prepared at JSC.

Project Assurance Engineering continues to assist QS20 in support of the STS-107 SRB Working Group investigation. PA has worked closely with QS20 and United Space Alliance (USA) in the refinement of the SRB investigation fault tree. PA, as the S&MA representative on the SRB Forward Separation Bolt Catcher Team, has reviewed bolt catcher supplier manufacturing data supplied by USA. Review comments were presented to QS20 and forwarded to the bolt catcher team leader for integration with other team member review comments in anticipation of the team's on-site visit to the USA subcontractor's (SUMMA Technology) facility.

Project Assurance Specialist provided QS20 reference information on the MSFC Hazard Analyses Fault Tree Double Diamonds and evaluated the HR/FMEA/CIL to Accident Tree efforts for the SSME, ET, SRB and RSRM providing comments to the QS40 manager and the respective authors. Supported the "Senior" Review Activities for the SSME and SRB working group teams' Fault Trees providing real time and follow-up comments. Supported the System Working Group including the System Group's review of the MSFC Element team's Fault Trees. Actively participated in the development of the System's working group Fault Tree. Provided several inputs to a System's Team cross-matrix that compared the MSFC SSP Element Working Groups fault trees, System Team Working Group Fault Tree, the JSC integration Office Fault Tree and the CAI Version 2.0 Fault Tree.

Shuttle PAE developed process flow diagrams reflecting generic element FMEA/CIL/HA change processing, MRB processing, and Problem Report (PRACA) processing. Also, developed a standardized FMEA/CIL/HA versus Element Fault Tree Compliance matrix.

At the request of the Program Office PAE initiated a Fault Tree Analysis (FTA) effort to focus on the anomaly that caused the PDU and ACE to fail. The FTA is in progress and it is estimated that it should be completed within a 30-day period. Incremental updates will be provided to the Program Office as they become available.

PAE participated in the GP-B Monthly Review presented by SU and LM. Also, assisted the SU Systems Effectiveness Manager in clarifying to Independent Review Team (IRT) members the meaning of an unrepeatable anomaly.

Project Assurance has supported the STS-107 RSRM Working Group investigation activities at MSFC. Project Assurance led an Independent Assessment of the Working Group's Fault Tree Analysis. The assessment included comparing the fault tree analysis to baseline risk documentation (RSRM Hazard Reports, FMEA/CILs, and Integrated Hazards). The assessment demonstrated that the investigation fault tree encompasses all hazardous causes documented in the baseline. PA presented the findings of the assessment to the Working Group, a Senior Independent Assessment Team, and the RSRM Project Office.

Project Assurance supported the STS-107 MSFC S&MA investigation activities in the S&MA Action Center. The PA manned the Action Center, coordinated S&MA Actions Items, collected and prepared daily notes from each investigation team for QS01, prepared S&MA briefing materials for the Columbia Accident Investigation Board (CAIB) visit to MSFC.

Project Assurance has supported the STS-107 SRB Working Group investigation activities at MSFC and on-site SRB Working Group investigation activities at United Space Alliance (USA) Booster Assembly and Refurbishment Facility (ARF). Upon arrival at the ARF, PA was assigned to the STS-107 Booster Separation Motor team. The team immediately proceeded with data review pertinent to documented problem reports, installation records, BSM deliverable data packages, and results of BSM supplier internal documentation review. The team also performed inspection on forward and aft BSM hardware flown on STS-107. During the BSM team activities, PA was reassigned to a new team formed to focus on the forward separation bolt catcher. PA support of the bolt catcher team investigation continues.

Project Assurance Engineering is actively involved in the preparation of the OSP Minimal Functional trade study to insure implementation of S&MA requirements in the study. This study is being performed using the Axiomatic Design approach. The axiomatic design approach will require approximately three weeks to finish. The study will then be presented to selected audience for comments and to NASA management for concurrence.

Product Assurance participated in the GP-B final spin/balance operations as the space vehicle test team successfully completed the 90+% full main tank spins. Spin rates of up to 40 revolutions per minute (RPM) were achieved. This activity completed spin/balance test operations thereby satisfying NASA critical milestone 36.

PAE for GP-B reviewed the final PDU and ACE Fault Tree Analyses (FTA) and distributed copies to the appropriate GP-B team members for comments. The few comments received were incorporated into the FTAs finalizing this activity. The system level FMEA will now begin.

Project Assurance Engineering closed an action to rebaselining the current RBCC/ISTAR S&MA plan to reflect the change in program direction to a sub-scale Ground Test Engine (GTE) development and test effort. The action required deletion of numerous outdated and/or obsolete reference requirements specifications contained in the current S&MA Plan as well as changing the numbers of other plans re-designated under the new numbering system (i.e. NGLT-RBCC-000TBD).

Project Assurance Specialist provided an event flow chart that identified the key block on the Integrated Tree for ET interface loads. Currently building a matrix that relates team data requests (48) to MSFC Element related blocks on the integrated Fault Tree. Initial inputs to the Fault Tree Section of the Draft System Working Group final report were submitted at the close of the reporting period.

HEI Project Assurance Specialist supported the RSRM Working Group on the Columbia Shuttle Investigation. The duties included technical review of RSRM build and flight documentation and building a database of the references cited in the Closure Forms of the RSRM Fault Tree. The final product will be a database that contains all the data used by the Team to support their findings. Also, continued to track the Data Requests and Action Items of the Working Group. These activities will continue through the investigation.

Project Assurance Specialist provided support to the Shuttle Systems Working Group (SSWG) performing Integration and Shuttle Element fault tree review/comments. Facilitated an update to the SSWG Fault Tree Cross Reference Matrix to map the MSFC Element's fault tree and the JSC CAI

Integration Fault Tree Blocks to the failure scenario. Also provided input to Code M letter on Return-to-Flight activities as related to MSFC.

Project Assurance Specialist provided review and comments to a proposed Independent Assessment Team Plan for assessing the STS-112 Hold Down Post Anomaly. Significant concerns were expressed as to the limited scope of the assessment. Rationale for expanding the scope was clearly identified and a proposed Fault Tree of the failure scenario was provided. The suggestion is to perform this IA as a return-to-flight action.

Product Assurance Engineering supported the GP-B monthly review at Stanford. APE completed the PDU and ACE Fault Tree.

Product Assurance Engineering supported the GP-B monthly review at Stanford. APE completed the PDU and ACE Fault Tree. A system level FMEA has been initiated.

4.7 Risk Management and Risk Assessment

4.7.1 Risk Management

A CRM training course was presented on January 15th and 16th 2003 to two projects in a combined session. In attendance were MSFC Project management and representatives of contractors involved in the projects. There were two contractor groups in Solar Sails, and six contractor groups in Aerocapture.

HEI CRM Project Assurance (PA) provided two days of Continuous Risk Management Training to the Integrated Engineering Capability project.

4.7.2 Space Shuttle Probabilistic Risk Assessment (PRA)

During this reporting period, Risk Assessment (RA) participated in a SSME PRA T.I.M at Pratt-Whitney to discuss SSME PRA results and methodology with the SSME PRA team (including Rocketdyne), SSME Project Office, and the PRA technical lead. RA is using methods determined at this meeting and during later teleconferences to perform a reallocation to balance SSME high pressure pump risk with the remainder of the engines. RA has nearly completed the analysis and will release results that are acceptable to all parties involved very soon. RA updated the ET PRA analysis with revised leak data from leak specification and PRACA (Problem Reporting and Corrective Action) entries.

RA is directly supporting the SRB project effort, and is assisting in adjustment of the SRB models in response to internal project review comments and comments from the PRA technical lead. RA supported two technical interchange meetings for the review of the RSRM PRA models by the RSRM project and with PRA Technical Lead. RA is currently preparing MSFC SAPHIRE models and draft documentation for April delivery to JSC.

In support of the Shuttle Life Extension Program (SLEP), RA provided lists identifying top drivers ranked by risk numbers to element project teams from the 1999 QRAS PRA.

RA also compiled a list of the ET Thermal Protection System (TPS) and other items that could be debris that are currently modeled in the 2003 ET PRA in support of the ET STS-107 investigation team. Events that only lead to Orbiter damage were groundruled out of the ET analysis by PRA project management.

4.7.3 Reliability Prediction & Risk Analysis

Risk Assessment (RA) provided fault tree (FT) expertise to the STS-107 Orbiter "Fault Tree Team" at JSC. RA actively participated in discussions on how to structure the FT and levels of detail to model. RA also participated in the modeling efforts that were conducted and helped ready material for presentation. The FT is truncated in areas that have good rationale for closure or deferment of modeling

due to low likelihood. This concentrates the modeling effort on all reasonable likelihood events. The activity culminated with very successful review presentations to the Orbiter Chief Engineer's Council and to the Orbiter Program Manager.

RA has provided extensive support to the ET working group that is investigating STS-107. An RA team member traveled to the Michoud Assembly Facility the day after the accident, and has been there a majority of the time since then. RA is actively working on the test sub-team, providing statistical expertise and analysis. RA made comments to proposers of several tests regarding the number of samples needed to produce usable results, randomization of tests to reduce unwanted effects of unknown variables, and application of Design of Experiments (DOE) techniques to improve tests' economy and significance of output. RA constructed a sampling simulation designed to show why small sample size and large standard deviation causes these errors and how this relates to statistical significance. RA also coordinated with DCMC at MAF and the S&MA ET team at Marshall on test fabrication and performance schedules as well as distributing test plans as they become available.

RA developed a set of scenarios that locate the cause of the STS-107 accident inboard of the Left Main Gear (LMG) box. Locating the initial fault in this area appears to explain the anomalous sensor readings shown on the Vehicle Data Mapping (VDM) team plot better than causes located out on the wing or at the MLG box itself. Other observations in the timeline and from recovered debris also appear to support the inboard scenarios. RA developed a detailed description of the scenarios and all supporting observations along with a list of suggested actions to either pinpoint or help clear the Mid Fuselage as the location of an initial fault.

RA provided extensive fault tree analysis support to the STS-107 MSFC Systems Working Group. RA constructed the Systems fault tree in the CAFTA software and made updates to it as required. RA also generated a cross-reference matrix between the MSFC Systems fault tree and the ET, RSRM, SRB, and SSME fault trees to check the completeness of the element fault trees. The cross reference was also extended to include the two JSC ("Orbiter" or "CAP" and the "Integration") fault trees. RA also assisted in a technical review of the four MSFC element fault trees.

A cracked BSTRA ball was discovered in the Orbiter Vehicle (OV) 103 Main Propulsion System. This caused a concern for OV-102 and STS-107, since the BSTRA balls on 102 could not be inspected without significantly delaying launch. Risk Assessment (RA) assisted MSFC M&P by statistically characterizing data from their tests of flawed and cracked BSTRA balls, estimating probable FOD sizes based on the available test data, and monitoring ongoing testing to look for statistically unusual occurrences. RA assisted JSC Safety, Reliability, and Quality Assurance staff in formulating a probabilistic risk assessment (PRA) model and in quantifying events in the model. RA also developed and fully quantified an independent PRA to verify results from JSC. It was found that the risk of generating FOD of sufficient size or quantity to degrade SSME performance or life limits is remote. RA produced charts showing that the freed particle ("raft") size distribution seen during testing implies release of no particles over any critical size range, and certainly in no quantity to cause concern. RA also provided data for several review presentations, including the JSC's risk assessment team's PRA presentation for a TIM held to discuss status and future work on the issue.

Low hardness and tensile strength readings were observed during MSFC M&P examination of properties on an ET Attach (ETA) Ring. RA examined data intended to prove a portable hardness tester for use in qualifying flight hardware. RA found that while the tester results are quite noisy, the noise is predictable and quantifiable. Using statistical methods called Measurement Systems Analysis (MSA), the tester output can be made useful. Analysis of the correlations between testers is in work.

ATK Thiokol produced more detailed finite element model representing RSRM propellant structure and stresses. In doing so, they uncovered a stress concentration potentially exceeding safety factor requirements in one area of the motor. RA was called upon to assess ATK's methodology in a PRA based on the improved stress model and work they had done correlating QA data and finished motors. RA found no issue with the approach or the calculations, which showed negligible probabilities of safety factors of 1.1 or less.

RA was requested to examine data regarding replacement of obsolete Shell 405 hydrazine catalyst. The manufacturer of the replacement S-405 catalyst had asked for an expanded specification on an acceptance test because of a more conservative testing method. RA determined that the data supplied is not sufficient to support widening the spec.

4.7.4 SLI Risk Assessment

A team has been set up by the OSP Project Office to examine the pluses and minuses to replicating the Space Station Risk Management database application at Marshall, for use on the Orbital Space Plane project. The ISS Risk Management differs somewhat from the MSFC approach, and its adaptability is being examined. A Statement of Work to transfer the ISS Risk Management Application (IRMA) to Marshall was completed by the OSP project and sent to JSC.

5.0 COST REDUCTION ITEMS

Our continuing cross-utilization of employees, continuous analysis of work in progress to assure that application of resources meets the needs of the task, and the judicious acquisition and distribution of tools to enhance the efficiency of all team members allow us to minimize cost to the customer.